Climate-in-a-Box (CIB) Workshop: Introduction and Overview

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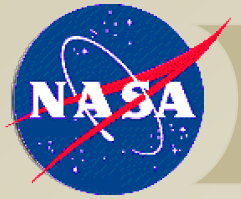
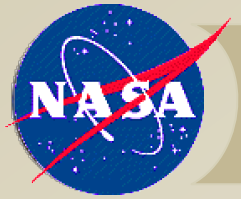


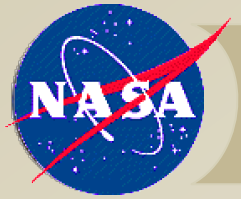
Vision

- Climate in a Box (CIB) seeks to:
  - Develop/improve models through a more efficient “open” model development and validation process
  - Open climate/Earth science model development and validation to a wider community



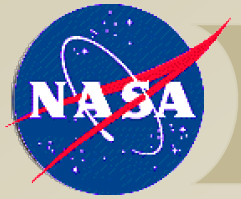
Motivations

- NASA/NOAA climate/earth science models are difficult to use
  - Can be challenging for domain experts
  - Non-typical users (e.g., non-domain scientists) may want to run models



Motivations

- Supercomputing resources are not always readily accessible
  - Wait times in job queues can be extensive
  - Arduous application process for foreign nationals



Goals

- Make NASA/NOAA climate/earth science models more accessible
- Explore desktop supercomputing architectures
- Package models and support software as a “toolkit” for desktop supercomputers
- Explore use of the system for “open” model development/validation

CIB Overview

Desktop System
(testing, development, lower resolution runs)

Preconfigured Toolkit

Data/Process Management Tools (workflow tool)

NASA/NOAA Models

Analysis Tools

User Additions

User-Provided Models/Tools

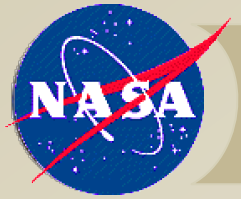
Model Run Information

Traditional Cluster
(high resolution runs)

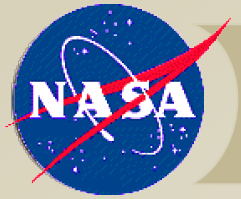
Workflow "Switch" Capability

Intial CIB Toolkit

- Models (ModelE, GEOS5, WRF)
- Analysis tools (GrADS, NCL, Panoply)
- Social networking/collaboration capabilities through NASA's Modeling Guru (modelingguru.nasa.gov)
- Process management tools (e.g., workflow tool/NASA Experiment Designer)

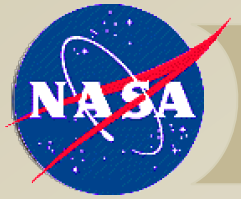


CIB Desktop Architectures



Desktop Architectures

- Cray CX1
  - Developed initial toolkit with 2 Cray CX1's
  - Used Linux and Windows HPC Server
- SGI Octane III
  - Evaluated as a test machine

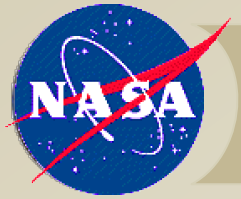


CX1 Configuration

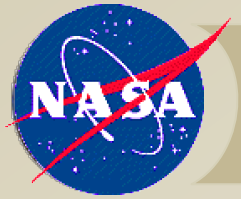
- 8 “compute nodes”
- Each node has
  - Two Intel 2.6GHz quad-core Nehalem CPUs
  - 24GB DDR2 RAM
  - One 320GB 7200rpm hard drive
- Infiniband and GigE networks connecting the compute nodes

Octane III Configuration

- 8 - 10 1U compute nodes
  - Two Intel 5520 2.26 GHZ Processors (8 cores total)
  - 150GB SATA 10K RPM Hard drive
  - 24GB RAM
  - GigE and InfiniBand network interfaces
- GigE and InfiniBand integrated switches

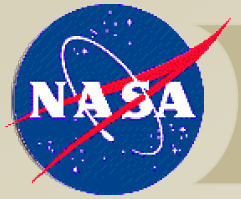


CIB Model Porting



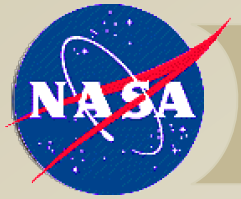
Model Porting Status

- Linux CX1
  - Open-source models
    - WRF, ModelE, GEOS-5 have been run successfully and validated on the CX1
  - Models not yet open-source
    - GFS, LIS, GEOS-DAS have been validated on the CX1
    - GDAS being ported to NCCS' Discover



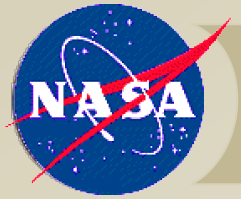
Model Porting Status

- Windows HPC CX1
  - ModelE built serially in Visual Studio
  - Incorporated PGI's port of WRF to Visual Studio 2008 into our Windows environments



Model Ports: Lessons Learned

- Linux ports were straightforward
- Windows HPC ports are more involved as models were written for Linux
  - Build/run scripts written for Linux shells
  - Language features are not always portable
  - Windows HPC best suited for existing Visual Studio developers

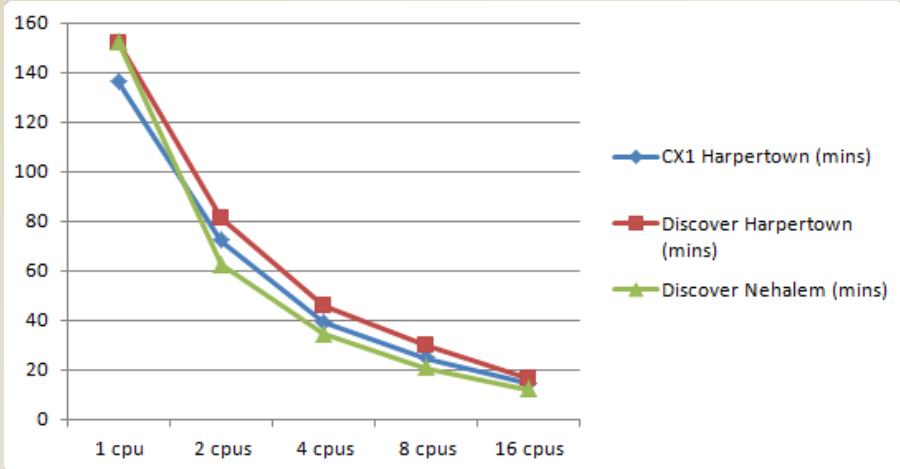


Timing and Accuracy Analysis

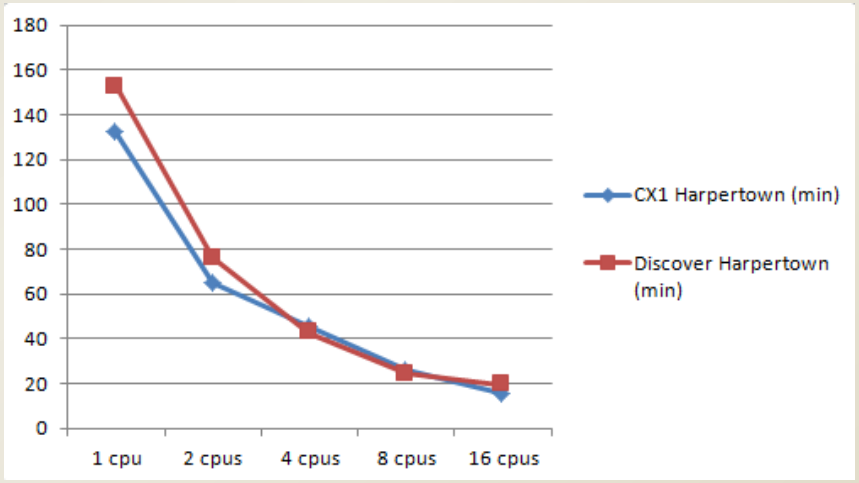
- On the Linux CX1, WRF, GEOS-5, and ModelE showed no difference in science results compared to runs on NCCS' Discover
- Linux CX1 shows comparable performance to Discover

Timing and Accuracy Analysis

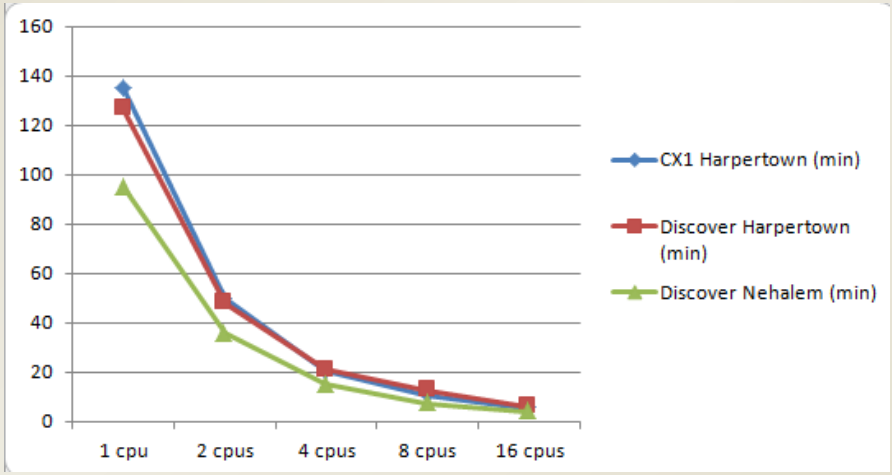
ModelE



WRF



GEOS5

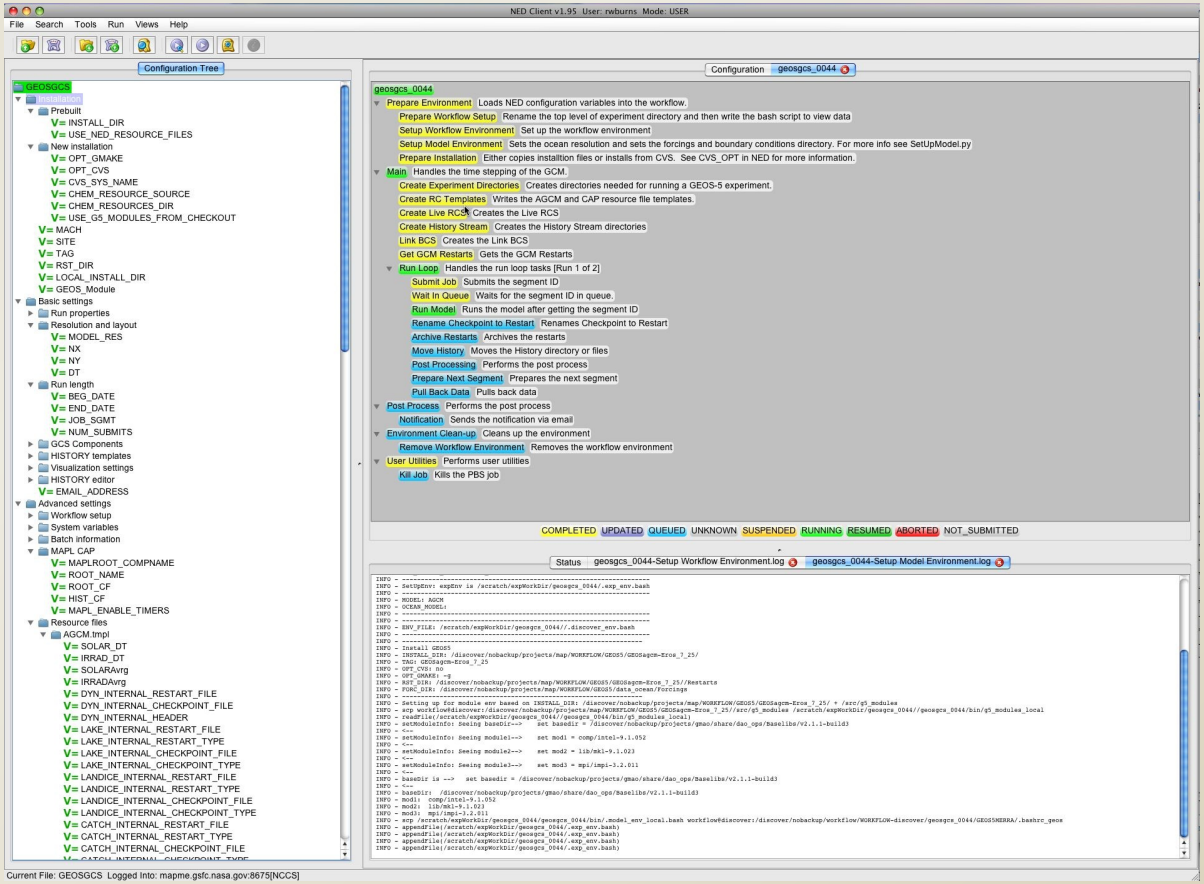


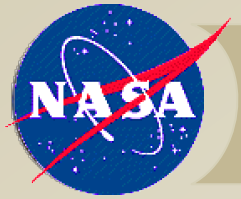
In-depth results are available on **Modeling Guru** modelingguru.nasa.gov

CIB Workflow Tool

Workflow Tool

- Simplifies/Automates model execution management and other processes
- Provides common look and feel between models and between systems
- Allows for experiment sharing and repeatability



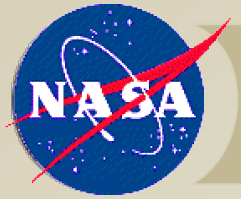


Workflow "Switch" Capability

- Enable model execution to be as seamless as possible between CIB and larger cluster or other CIBs
  - CIB can be used for testing and lower resolution simulations
  - Large HPC systems can be used for validation and simulations at a higher resolution

CIB Workflow Tool Status

- Workflow tool GUI client & server have been tested and validated on the CX1s
- Model workflows for GEOS-5 and WRF are part of the toolkit
- Workflow “Switch Capability” has been implemented



CIB Workshops and Users

CIB Workshops

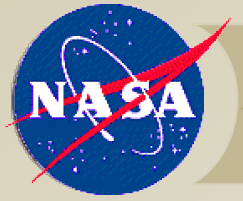
- CIB Workshop I, March 2010
  - Provided an overview of the CIB project
  - Potential users showed how they might use CIB
  - Attendees:
    - NASA: GSFC, GISS, HQ, NAS
    - Southeast Climate Consortium
    - University of Michigan
    - AOML
    - Columbia University (CIESIN, CCSR)
    - USGS
    - Great Northern Landscape Conservation Cooperative

CIB Workshops

- CIB Workshop II, September 2010
  - CIB team trained users on the CIB toolkit on a CX1
  - Focused on running models, using the workflow tool and building new workflows
  - Attendees: GSFC, MSFC, USGS, JPL, GISS

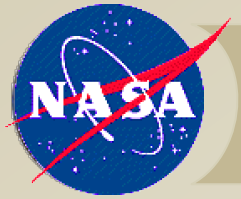
CIB User Status

- MSFC
  - CIB toolkit installed on two CX1s
  - Will primarily focus on operational weather simulations with WRF
- GISS
  - Will be receiving an Octane III and toolkit soon



Summary

- Developed a CIB toolkit that significantly reduces the time needed by new users to begin running NASA and NOAA earth science models
- Added new features to the workflow tool, including the switch capability
- Investigated two desktop architectures for use in CIB
- Held two workshops to introduce users to CIB
- Working to establish a “project release” license for the toolkit

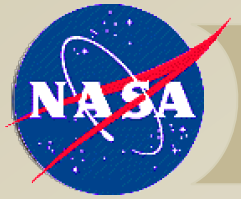


Next Steps

- Improve the User Interface
- Develop automated software synch/ update capability
- Explore virtualization as a way to deliver the toolkits

Videos at NASA Booth

- CIB video
- Workflow tool video
- Snowfake video
- Gtraj video



Thank you!

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